

CHAPTER 1 INTRODUCTION

1-1. General. This manual presents general guidance for the preparation of site-specific operation and maintenance (O&M) manuals for the basic land treatment systems used to treat wastewaters, and to supplement O&M information already provided for existing systems. There are three basic systems that differ in the rate at which water is applied and in the flow path of that water after application. These systems are as follows.

a. Slow rate. This type of system is similar to conventional agricultural irrigation practice. Wastewater is applied to an area covered by vegetation. The vegetation is an essential component in the system and the applied wastewater is treated as it trickles down through the soil and the root zone of the crop. A typical loading for a site in the northern U.S. might be about 2-1/2 million gallons of wastewater per year per acre. Chapter 2 provides additional details on the process and necessary site conditions.

b. Overland flow. In this type of system, wastewater is applied at the top of gently sloping grassed fields. The surface has been smoothed during construction so the wastewater flows down the slope in a shallow sheet to collection ditches at the toe. The soils are usually clays or other impermeable types. The wastewater is treated as a result of contact between it and the grasses, the soil surface and the organic mat on the slope. Annual loading for a site in the northern U.S. might be about 5 million gallons of wastewater per year per acre. Chapter 3 provides additional details on the process.

c. Rapid infiltration. This type of system uses flooding of open basins in sandy soils. Vegetation in the basins is not necessary for treatment. The wastewater is treated as it percolates through the upper soil layers. A typical loading for a site in the northern U.S. might be about 32 million gallons per year per acre. Chapter 4 provides additional details on the process.

1-2. Purpose and scope. This document has two basic purposes. It can be used by the operators of existing and future systems to supplement the O&M information furnished to them on the mechanical elements in their systems. It can also be used as a guide for the preparation of future O&M manuals. The writer of the O&M manual can take the necessary chapters from this document and add them to the specific information on operation and maintenance of the equipment involved. Operators of existing systems only need to be concerned with those chapters covering the type of process they are responsible for. The types of equipment that can be used and the possible combinations are almost infinite, so this document cannot possibly cover all of that material. This manual does provide the fundamental procedures that are common to the basic land treatment systems. Special conditions that are unique to a single site are also beyond the scope of this document and must be included in portions of the site-specific O&M manual. There is some duplication in this document between the technical chapters because

there are common elements in the various processes and each chapter is intended to stand independently. The operators and future manual writers using this document should be primarily concerned with the chapter describing the process of interest to them and appendix A. However, chapter 2 does contain the most detail on monitoring procedures that may also be applicable to the other systems, so these sections should be consulted if monitoring is an issue of concern.

1-3. Definitions.

Acre-foot — A liquid measure of a volume equal to covering a 1-acre area to 1-foot of depth.

Aerosol — A suspension of colloidal solid or liquid particles in air or gas, having small diameters ranging from 0.01 to 50 microns.

Aquiclude — A geologic formation which, although porous and capable of absorbing water slowly, will not transmit it rapidly enough to furnish an appreciable supply for a well or spring.

Available moisture — The part of the water in the soil that can be taken up by plants at rates significant to their growth; the moisture content of the soil in excess of the ultimate wilting point.

Available nutrient — That portion of any element or compound in the soil that can be readily absorbed and assimilated by growing plants.
("Available" should not be confused with exchangeable.)

Evapotranspiration — The combined loss of water from a given area and during a specified period of time by evaporation from the soil surface, snow or intercepted precipitation, and by plant transpiration and tissue building.

Field area — The "wetted area" where treatment occurs in a land application system.

Field capacity (field moisture capacity) — The moisture content of soil in the field 2 or 3 days after saturation and after free drainage has practically ceased; the quantity of water held in a soil by capillary action after the gravitational or free water has been allowed to drain; expressed as moisture percentage, dry weight basis.

Fragipan — A loamy, dense, brittle subsurface horizon that is very low in organic matter and clay but is rich in silt or very fine sand. The layer is seemingly cemented and slowly or very slowly permeable.

Horizon (soil) — A layer of soil, approximately parallel to the soil surface, with distinct characteristics produced by soil-forming processes.

Infiltrometer — A device by which the rate and amount of water infiltration into the soil is determined (cylinder, sprinkler or basin flooding).

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Lysimeter — A device for measuring percolating and leaching losses from a column of soil. Also a device for collecting soil water in the field.

Micronutrient — A chemical element necessary in only trace amounts (less than 1 mg/L) for microorganism and plant growth. Essential micronutrients are boron, chloride, copper, iron, manganese, molybdenum and zinc.

Mineralization — The conversion of a compound from an organic form to an inorganic form as a result of microbial decomposition.

Sodic soil — A soil that contains sufficient sodium to interfere with the growth of most crop plants, and in which the exchangeable sodium percentage is 15:1 or more.

Soil water — That water present in the soil pores in an unsaturated (aeration) zone above the groundwater table. Such water may either be lost by evapotranspiration or percolation to the groundwater table.

Tensiometer — A device used to measure the negative pressure (or tension) with which water is held in the soil; a porous, permeable ceramic cup connected through a tube to a manometer or vacuum gauge.

Till — Deposits of glacial drift laid down where the glacier melts, consisting of a heterogeneous mass of rock flour, clay, sand, pebbles, cobbles and boulders intermingled in any proportion; the agricultural cultivation of fields.

Tilth — The physical condition of a soil as related to its ease of cultivation. Good tilth is associated with high noncapillary porosity and stable, granular structure, and low impedance to seedling emergence and root penetration.

Transpiration — The net quantity of water absorbed through plant roots that is used directly in building plant tissue or given off to the atmosphere as a vapor from the leaves and stems of living plants.

Volatilization — The evaporation or changing of a substance from liquid to vapor.

Wilting point — The minimum quantity of water in a given soil necessary to maintain plant growth. When the quantity of moisture falls below this, the leaves begin to drop and shrivel up.